

The Life and Work of E.G.R. Taylor (1879-1966), author of *The Mathematical Practitioners of Tudor and Stuart England* and *The Mathematical Practitioners of Hanoverian England*.

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Foreword

This is an updated and annotated version of the E.G.R. Taylor Lecture, delivered at the Royal Geographical Society on 13 October 2005 at the invitation of the Hakluyt Society. While some overlap was unavoidable, the text is distinctly different from my paper “A Chronicle of Lesser Men”. E.G.R. Taylor and her *Mathematical Practitioners of England*, published in the *Bulletin of the Scientific Instrument Society*, 81, June 2004, pp. 31-3. Much information given in that paper is not included here.

In an appendix, Taylor’s books, including editions for the Hakluyt Society, are listed. For an exhaustive bibliography, arranged chronologically from 1905 to 1966, see *Transactions of the Institute of British Geographers*, 45, September 1968, 182-6.

To reduce the number of notes, an asterisk before a name when first mentioned refers to an entry in the *Oxford Dictionary of National Biography*.

Introduction

Eva Taylor, who died almost forty years ago at the age of eighty-seven, was a geographer who devoted most of her scholarly work to the study of the history of her subject, of which she took a broad view. As she phrased it in a preface to one of her earliest books, *Late Tudor and Early Stuart Geography*, published in 1934: ‘The term geography has designedly been interpreted in its widest sense, to include voyages and travels; maps and survey; mathematical geography and navigation; general, regional and descriptive geography; human, political and historical geography; physiography and economic geography’. On the history of these topics she published ten books, including four editions for the Hakluyt Society, and well over a hundred articles and contributions to multi-authored volumes.

Perhaps I should explain why a Dutch historian who never met Eva Taylor should discuss her life and work before a British audience that includes several people who have known her personally. After reading history at the University of Amsterdam, I worked at the Museum Boerhaave, the Dutch National Museum of the History of Science and Medicine in Leiden. And it was through the history of scientific and precision instruments and their makers that I came across E. G. R. Taylor.

There is by now a vast literature dealing with the instrument makers of the past, the men who made and supplied apparatus to surveyors and navigators, science teachers, astronomers, and so on. Within this literature there are classics which continue to be read and consulted, even if they are gradually being overtaken and corrected by later

research. Among these are two books that have made E. G. R. Taylor a household name among instrument historians. *The Mathematical Practitioners of Tudor and Stuart England* and its sequel *The Mathematical Practitioners of Hanoverian England* represent landmarks in the study of instruments. These are essentially biographical and bibliographical reference works, and as such I sometimes consulted them, but without giving any thought to the identity and the remarkable career of their author.

This changed when in the electronic catalogue of the British Library manuscripts I found listed 'The E. G. R Taylor papers',¹ described as 'Notebooks and papers, principally relating to the history of cartography, science, mathematics, navigation and instrument makers; mostly no date. Including numerous transcriptions of documents'.

Out of curiosity, I took a look at this material and became interested. As it was exactly half a century ago that the first volume of *The Mathematical Practitioners* was published, I decided to write a note about Taylor's contribution to the historiography of instruments and instrument makers for the *Bulletin of the Scientific Instrument Society*, a club of instrument enthusiasts in which I am actively involved.² This short article led to my being invited to deliver this lecture. I am honoured, and shall do my best to do justice to Eva Taylor's memory.

Sources of information on E. G. R Taylor's life and work

The obvious starting point for anyone interested in the life and work of Eva Taylor is the entry in the *Dictionary of National Biography*, written in 1981 by Eila Campbell, who had followed in Eva Taylor's wake and knew her better than perhaps anyone. The entry was reprinted, with some updates, in the *Oxford Dictionary of National Biography*. Had she not died in 1994, surely Eila Campbell would have been the ideal candidate to give this talk about her mentor. Then there are obituaries and appreciations that appeared in the various journals to which Eva Taylor contributed.³ These contain lists of her books and articles; the *Transactions of the Institute of British Geographers* even supplied a complete bibliography. I read or looked through her scholarly production selectively (there was no way I could read it all) and also tried to locate book reviews to get a sense of how her work was valued and received at the time it appeared.

To add a personal element, I wanted to get in touch with people who had known her well. Ann Shirley, Vice-President of the Hakluyt Society, kindly brought me into contact with Mr Michael Richey and Professor Bill Mead, and I wish to thank them for their willingness to share their memories of Eva Taylor with me.

¹ British Library Manuscript Department Add. 69466-69490, presented by Eila M. Campbell in 1981 and transferred from the Map Library in 1989. In 1994, Prof Peter Campbell presented further correspondence and papers of, and relating to, Eva Taylor, and these are Add. 71872-71874.

² Peter de Clercq, 'A Chronicle of Lesser Men'. E. G. R. Taylor and her Mathematical Practitioners of England', *Bulletin of the Scientific Instrument Society*, 81, June 2004, pp. 31-3. On this Society see: www.sis.org.uk

³ Obituary, anonymous, with exhaustive bibliography, in *Transactions of the Institute of British Geographers*, 45, September 1968, pp. 181-6. Obituary by R. A. S. [= Skelton] with photo portrait and selective bibliography in *Imago Mundi*, 22, 1968, pp. 114-16. Obituary, with line-drawn portrait, selective bibliography and multi-authored appreciation in *Journal of the Institute of Navigation*, 20, 1, 1967, pp. 94-101.

Michael Richey, who was Executive Secretary (that is: Director) of the Royal Institute of Navigation from its creation in 1947 until 1983, has worked closely with Eva Taylor. In 1962 they even produced together an attractive slim volume – in Eva Taylor’s own words: ‘essentially a picture-book’ – on early nautical instruments. In an earlier E. G. R. Taylor Lecture, on the subject of the enigmatic Vinland Map, Michael Richey discussed Professor Taylor’s criticism of the map, calling her ‘almost certainly the first scholar to set down in detail the reasons for believing the map to be a forgery’.⁴ We met and corresponded, and he even lent me Taylor’s notes and letters in his possession, dating from the 1950s and 1960s.

The Finland expert, Bill Mead, Professor (now Emeritus) of Geography at University College London, first met Eva Taylor in 1946. We spoke over the telephone and he wrote down for me some personal recollections, which further brought out her formidable personality.

What I did not find was any interesting visual material. There are a few photographic portraits in the files in the British Library, including the one shown traditionally projected at E. G. R. Taylor lectures and which, I feel, is indeed the best. No photographs were found of Eva Taylor at work – researching or lecturing – or at home.

Career

Eva Germaine Rimington Taylor’s was born in 1879 in Highgate, North London, the daughter of a solicitor. Her childhood was problematic; when she was three years old, her mother ran away. Her father, a solicitor, sent her to two local schools, the North London Collegiate School for Ladies and the Camden School for Girls, which had recently been founded especially for middle-class girls by a pioneer in education for women, *Frances Mary Buss. Both schools are still going strong; in fact, my own daughters are at the Camden School for Girls, which indirectly gives me a certain sense of personal connection to Eva Taylor. Miss Buss died in 1894, so she was still head mistress when Eva visited her schools, but she did not live to see her pupil move on to university.

It may come as a surprise that Eva originally opted for chemistry. She obtained her bachelors degree at the University of London, and for a few years taught chemistry at schools. However, this was a short-lived affair and she switched to geography in her mid-twenties, enrolling at Oxford University where she obtained the certificate of regional geography and the diploma of geography. For some years she was a private research assistant to *A. J. Herbertson, head of the School of Geography at Oxford. He wrote in a testimony that he considered her the most brilliant and able of the many women students trained under him at Oxford. In this period, the 1910s, she wrote some highly successful geography textbooks for schools and drafted wall-maps.

In 1920, Eva became a part-time lecturer at the East London College. The next year she moved to a similar post at Birkbeck College, which was to be her academic home for the rest of her life.

Eva Taylor never married, yet she had three children, all boys, born between 1912 and 1919. One died in infancy, but Eila Campbell assures us that Eva Taylor proved a devoted mother to the other two. For some time, Eva was the partner of Herbert Edward Dunhill, of tobacco fame (in 1912 he joined his elder brother *Alfred Dunhill

⁴ Michael Richey, ‘E.G.R. Taylor and the Vinland Map’, *The Journal of Navigation*, 53, May 2000, no. 2, pp. 193-205.

in the pipe and tobacco manufacturing business), who, we are told, was the father of 'at least one of the boys'. It all sounds rather modern, almost bohemian. However, we need not dwell on her private life, but only observe that, while she was finding her feet at Birkbeck in the 1920s, she was raising two young boys.

In 1930, aged fifty, she was appointed (in open competition) to the chair of geography, a post which she held for fourteen years until her retirement in 1944; but she remained in touch and in 1960, she was elected one of the first Fellows of Birkbeck College.

A few words about this institution.⁵ It had been founded in 1823 as the first Mechanics Institute in London and was the first college in England to provide education to people who earned their living during the day. It became a school of the University of London just at the time when Eva joined, but it remained, and still remains, dedicated to teaching evening and part-time students. In those days, Birkbeck College was not yet located in the present building in Malet Street near the British Museum (that dates from 1951), but in a late-19th century pile named Breems Buildings in Holborn, off Chancery Lane. During the 'phony war' period, Professor Taylor instructed officers of the Eastern Command in map-reading and interpretation. Famously, when the Blitz came, Birkbeck was the only university institution in London to stay open, despite ferocious bombing and a direct hit on the library.

Women as university professors and geographers

With her appointment in 1930 Eva Taylor became the first woman to occupy a chair of geography in the United Kingdom. To see this in perspective, let me point out that the first female professor in England had been appointed seventeen years earlier; this was the literary scholar *Caroline Spurgeon, who worked at Bedford College in London. Eva Taylor was also not the first female professor at Birkbeck; that was the mycologist *Helen Gwynne-Vaughan, a prominent women's activist, who was appointed in 1921. On the other hand, and perhaps not surprisingly, in Oxbridge it all happened much later, first with Cambridge appointing the archaeologist *Dorothy Garrod in 1939, while in 1948 the historian *Agnes Headlam-Morley was the first woman to be elected to a full professorship in Oxford.

I will not go into this gender business any further, but only point out a current research project into the role of women in the academic discipline of geography. It is funded by the British Academy and carried out by Avril Maddrell from the Department of Geography at Brookes University Oxford. She is looking at the careers of women involved in geographical work from 1850 to 1970 as for example lecturers, teachers, travel writers and authors; her sample does include Eva Taylor.⁶

⁵ <http://www.bbk.ac.uk/bbk/history/>

⁶ Based on a brief report on the project which I found on-line at <http://ssl.brookes.ac.uk/Newsletter-5-2004/resReports/complexLocations.htm> with vignettes of the women geographers covered in her sample. Beside Eva Taylor these are Mary Somerville, Catherine Raisin, Marion Newbigin, Joan Reynolds, Hilda Ormsby and Alice Garnett.

In an e-mail (23 Jan 2006), Avril Maddrell supplied the following update:

I gave a paper on Taylor at the International Geographical Union 2004 in Glasgow titled: 'Eva Taylor. A Voyage of Discovery' but this has not yet been worked into a published paper. I mention her in my chapter A. Maddrell, (2004) 'Complex Locations. Historiography, Feminism and Difference', in J. Sharp and F. Smith, eds, *Geography and Gender Reconsidered*, RGS-IBG Women and Geography Study Group, London. I am currently writing a book on women geographers and travellers: *Complex Locations: women's geographical work and the canon 1850-1970*, Royal Geographical Society / Institute of British Geographers series, Blackwells (to be completed July 2006, publication date May

Continued activity after retirement

After her retirement in 1944, Professor Emeritus Taylor lived on for more than two decades, continuing to work with vigour well into her eighties, producing what are probably her three greatest books. One gets the impression that she really lived for her work, her research, her writing. In July 1953, discussing the production of *The Mathematical Practitioners of Tudor and Stuart England*, she wrote to Michael Richey:

I don't want any expenses, as the writing etc. I treat as a hobby & spend money on it accordingly. I am not hard up, as I can't go out & about, and the book (or books) make my only amusement.

She lived in Bracknell in Berkshire, but would return to London for research, for committee work or to give or to attend lectures, when she used as a pied-à-terre a small flat near Birkbeck College. Michael Richey remembers visiting her there and being struck by seeing several nude paintings on the walls. They were by *William Ety, whose nudes, painted towards the end of his life in the early Victorian period, are held in high regard.

As her letters testify, she was often struggling with her health at this late stage of her life, at times even bed-ridden. But she remained upbeat and of independent spirit. In December 1959, aged eighty, she wrote to Michael Richey from her bed about 'threatenings of phlebitis or some such tiredness', adding that people wanted her to go to 'a nice nursing home, - a contradiction in terms'. In another, undated, letter to him she wrote how the winter weather made travel difficult, rendering it almost impossible for people to get to her; her house was often inaccessible anyway due to interminable roadworks and apparently clumsy planning by the local authorities: 'Of course the snow stopped the promised visits of my son & my sister. Perhaps just as well. I hate being treated as a "problem"':

In 1964, a stroke damaged an optic nerve and impaired her sight, so that she was unable to continue her studies. Letters in the British Library show how Eila Campbell effectively acted as aid and secretary to her mentor in her final years. Eva Taylor died at St Anne's Nursing Home, Wokingham, Berkshire, of heart failure on 5 July 1966, at the age of eighty-seven. In his obituary in *Imago Mundi*, the cartographic historian *R. A. Skelton wrote that her 'valuable working library' was bequeathed to Birkbeck College, but when I enquired, I learned that Taylor's books are not a discrete collection within Birkbeck Library. But many of her research notes, as I have mentioned, are in the British Library, there for everyone to study.

Pioneer studies in the development of English geographical thought and enterprise

Having outlined Eva Taylor's life and her career, I shall now turn to her scholarly work. This, as I have mentioned, was mainly historical, but this does not mean there were no articles, reports, lectures or reviews on modern questions, such as the distribution of the industrial population or the desirability of a National Atlas of

2007), in which EGRT's work is an important part, so I will be glad to be able to cite your work alongside my own research.'

Britain as a basis for national and regional planning, or for that matter, aircraft. As Professor Mead wrote to me:

The first lecture that I heard her give was at the 1946 meeting of the Geographical Association. [...] It was on 'Airways of the Empire' and I recall her assistant Eila Campbell (later Professor) holding up a hand-drawn map throughout the three quarters of an hour talk while E. G. R. Taylor pointed at its features intermittently.

In other words, Eva Taylor did not live in the past. Having said that, in a way perhaps she did. Michael Richey told me how, when they walked passed Prince Albert's effigies in the Memorial in Kensington, which is just opposite the Royal Institute of Navigation, she said 'Look at him, Old Albert, as if he never needed to brush his teeth or anything'. And this, he commented in a letter to me,

was characteristic in a way because it showed her tendency to think of historical figures as still with us. She had dreams about them. To some extent she looked on them much as Christians think of the Communion of Saints.

It was during her early Birkbeck years that Eva Taylor began her pioneer studies in the development of English geographical thought and enterprise, with a keen eye to the practical requirements of explorers and surveyors. Her first historical article, 'The Earliest Account of Triangulation', appeared in the *Scottish Geographical Magazine* in 1927. From then on, there is steady trickle of historical articles, with a relative lull during and immediately after the war, but growing into a constant stream from the late 1940s right into the 1960s.

Her first historical book, *Tudor Geography*, was published in the year that she became professor, 1930. It was, in her own words, an attempt 'to depict the background of geographical thought and nautical theory that formed the setting of the English Voyages for Trade and Discovery down to 1583'. Four years later followed the sequel volume, *Late Tudor and Early Stuart Geography*. Both books offer expository chapters, written with the absolute mastery of language and in the terse style that characterized all her writings. These chapters are supported by full chronological lists of English geographical literature, both printed and in manuscript, up to 1650, and these bibliographies, she stresses, formed the core of the books.

In her preface to the sequel volume of 1934, Taylor shows her mettle as historian:

It will be objected by many that the writers are inaccurate and ill-informed. That is true, but it is also true of our modern Daily Press: each mirrors current thought and belief, rather than current fact. And it is upon thoughts and beliefs, however faulty, that men act. The present writer's purpose is not to reconstruct the Geography of the seventeenth century as it was, but as men believed it to be.

A case in point is contemporary writing on natural disasters like floods and earthquakes. These prepared the way for a study of physical geography, but in Elizabethan England, many authors would regard these disasters not just as natural phenomena, but also as signs and portents, as warning of God's power and wrath. Discussing an earthquake that hit south-east England in 1580, Taylor quotes a treatise

by *Arthur Golding who held it to be a divine warning for the follies of the day that called for rebuke from heaven, such as young people being forward and ill-mannered.

Perhaps I may point out a terrible irony, which Taylor did not note, and I assume did not even notice. She writes that the earthquake of 1580 was 'a comparatively slight affair, and indeed in its range and intensity appears to have closely resembled the English earthquake of 1931. The only casualty was in a church near Newgate, where a loose piece of masonry was dislodged and killed two young people who were at their prayers'. So while a contemporary author saw the earthquake as a sign of God, as a warning against what we might now call the yob-culture of the young, the only two people who were actually killed were not at all engaged in such sinful activities as visiting the theatre or the alehouse. Quite to the contrary: they were struck dead by bits falling off the church where they were - praying! God surely works in mysterious ways, and one can only wonder what their friends and family made of it. Eva Taylor in any case does not offer any comment, and perhaps she simply did not notice the irony of it.

Work for the Hakluyt Society

It was also in the early 1930s that Eva Taylor joined the Council of the Hakluyt Society, which had been founded in the mid-19th century to publish historic voyages and geographical texts. Here Taylor must have felt like a fish in water. In the early 1930s, she edited two volumes, with long introductory chapters: *A Brief Summe of Geography* by *Roger Barlow and *The Original Writings and Correspondence of the two *Richard Hakluyts*. Towards the end of her life - by then she had been elected Vice-President - she prepared another two volumes for the Society. In 1959, in *The Troublesome Voyage of Captain *Edward Fenton*, she brought together documents related to a failed attempt in 1582 to establish the first English trading base in the Far East. And in 1963, three years before her death, there followed *A Regiment for the Sea and other Writings on Navigation by *William Bourne of Gravesend, a Gunner (c. 1535-1582)*. In the preface she wrote:

The interest taken today by so many people in the early history of science and technology suggested to the present editor that it would be appropriate to publish among the Hakluyt Society's volumes what is perhaps the earliest technical manual written by an Englishman. The Council of the Society agreed, for it was a Seaman's Manual, fitted therefore to accompany and illuminate the history of great sea-voyages, with which the name of the Society is associated.

I think that this indicates how much influence she had in the Hakluyt Society. These were no travel journals, but the writings of a man who, for all we know, hardly ever ventured outside his home town of Gravesend. His personal experiences, combined with a considerable, self-taught, knowledge of mathematics, had enabled him to become a mathematical practitioner, dealing with almanac-making, surveying, navigation, and gunnery, and satisfying a demand for practical textbooks on these topics. I think she had a particular liking for him, witness her sympathetic biographical introduction, which concludes:

It was no great disadvantage to William Bourne that he was, as he termed himself, a 'simple man'. He was also an intelligent one, a man who reflected on what he saw. And his books were read.

The Haven-Finding Art

In 1956, Eva Taylor published *The Haven-Finding Art: a History of Navigation from Odysseus to Captain Cook*, which has been praised for being 'both in scope and authority, perhaps the most definitive book of its kind'. Michael Richey, who has a life-long experience as navigator and has made many single-handed Atlantic crossings, told me that Eva Taylor was not at all one to venture out on the sea. This may come as a surprise, considering that she wrote with such deep understanding of the way men found their way over the oceans. But then, as a Dutch maritime historian once put it in jest,

To ask a maritime historian 'Do you sail?', is like asking an agrarian historian 'Do you have any livestock yourself?' or an historian of criminality: 'Have you been out on many jobs lately?'.⁷

Speaking of surprise, here is what Eva Taylor herself wrote to Michael Richey in August 1952, 'I did not think non-navigational females were eligible for membership of your Society', referring, I assume, to the Society for Nautical Research.

The Mathematical Practitioners

I now come to Taylor's two monumental books on the mathematical practitioners that are generally considered her *chef-d'oeuvre*. Mathematical practitioners, like the sixteenth-century William Bourne whom we have just met, were the men who put mathematics to practical uses, in contrast to the academic or gentleman 'philomaths' who engaged in the study of mathematics for its beauty and for the love of it. They earned their living as teachers, text-book writers, technicians and craftsmen, making or designing instruments, compiling nautical manuals, laying out fortifications or calculating the ballistics of ordnance, and so on. Eva Taylor became as it were the champion of this varied professional group, tracing its rise to prominence in the British Isles from the late fifteenth century onwards to their heyday in the seventeenth and eighteenth centuries, eventually taking the story into the early Victorian period. Through years of painstaking research she identified some two-and-a-half thousand of these men. All her data found their way into an ever-growing card index, which unfortunately does not appear to survive, but it seems that all the information eventually made it into print, so this is not such a dramatic loss for scholarship as it might seem.⁸

⁷ In Dutch academic culture, the doctor's title is conferred after a somewhat theatrical public debate. Apart from the PhD dissertation itself, the candidate is usually expected to provide a series of theses ('stellingen') as potential ammunition for the debate. This thesis (translated here from the Dutch) came with C. A. Davids, *Zeewezen en wetenschap. De wetenschap en de ontwikkeling van de navigatietechniek in Nederland tussen 1585 en 1815*, Amsterdam/Dieren, 1985.

⁸ In my paper on Taylor (n. 2 above) I wrote of the original index cards 'Anita McConnell informs me that these index cards are preserved in the Institute of Navigation. Some years ago she went through them to see if they contained important information that had not been used in the publication, but found this not to be the case'. When later I asked to see these originals, the librarian, Heather Leary, informed me that they cannot be found and must be presumed lost. A microfilm version of the index card, which

In the early 1950s, Eva Taylor began to organize her material for publication and her notes show her groping for a title. Among the notes in Michael Richey's possession are an undated *Proposal for a Memoir on the English Mathematical Practitioners of the 16th and 17th Centuries with special reference to Navigation, Surveying and Chart and Map-Making*, and a letter written in June 1952 in which she throws up various alternatives, also mentioning Gunners, Engineers, Instrument Makers and Instructors until the title threatened to become as unwieldy as that of many a seventeenth or eighteenth-century treatise. She eventually settled for the compact title *The Mathematical Practitioners of Tudor and Stuart England*. The book opens with a narrative, without any references, aimed as she put it at those with more general interest. The student of the history of science will find the details he is likely to want in the Biographies and in the annotated list of Contemporary Works'. These two bulky parts are the core of her book. First a database of almost six hundred biographies of practitioners, active between 1485 and 1714. And then what she calls 'Works on the mathematical arts and practices', listing and describing hundreds of printed books and manuscripts written in the vernacular by many of these practitioners.

When the book came out in 1954, just half a century ago, it was welcomed by historians of science. Alfred Rupert Hall, who was emerging as a leading historian of the scientific revolution, wrote: Professor Taylor has drawn a fascinating cross-section through that aspect of the scientific revolution in England which was most clearly practical and of general concern to contemporaries'.⁹ Derek Price, honorary curator of the Whipple Museum of the History of Science in Cambridge, wrote Professor E. G. R. Taylor's new book contains the result of a comprehensive and detailed research into the lives and works of these minor characters on the stage of science. For the first time, it can be seen how enormous is the aggregate of their efforts and how much has been lacking from previous histories.¹⁰

Having taken the story up to the early eighteenth century, Taylor then set herself the task of preparing the sequel volume *The Mathematical Practitioners of Hanoverian England*. Again there was to be a narrative for the general reader, followed by a long list of biographical entries of mathematical practitioners, some two thousand this time. Again, as she had done for the earlier volume, she found her source material in the publications of the practitioners themselves, such as text-books and manuals and instrument makers' trade catalogues. She also consulted Directories for London and for provincial towns, the *Proceedings of the Royal Society*, the *Philosophical Magazine* and many other contemporary publications. The amount of time she must have spent beavering away in the libraries, sifting through all this material, is daunting. She had no research assistants, but fellow researchers in the field readily supplied her with information, happy to contribute to her wonderful

Eva Taylor had arranged to be made and deposited at Birkbeck College for researchers, can also not be located. However, during the discussion following my lecture, it emerged that a photocopy version survives in the National Maritime Museum, where it can be consulted by appointment. On 26 May 2006 I was able to see this material, which is part of an old card index database preserved in the office of the Senior Curator of Horology, Jonathan Betts. The relevant material is a few hundred photoprints of a microfilm of Taylor's cards of the Hanoverian volume only, which were filed by the museum in February 1963.

⁹ A. R. Hall, 'Mathematical Tradesmen', *The Cambridge Review. A Journal of University Life and Thought*, LXXVI, no. 1857, Saturday April 23, 1955, p. 455, under the heading 'Applied Science'.

¹⁰ Derek J. Price, 'The Mathematical Practitioners', *Journal of the Institute of Navigation*, 8, 1, January 1955, pp. 12-16.

database. These included the staff of museums with collections of scientific instruments. It is perhaps worth pointing out that not all mathematical practitioners were as well documented as William Bourne. Some were only known through a signature on a single instrument in a museum.

Eva Taylor did not find it easy found to write the narrative section of the sequel volume. She wrote in a letter to Micheal Richey:

I simply cannot reflect on Elizabethans and Georgians simultaneously so I've made up my mind to polish off Hakluyt this week-end [this must be reference to the edition of the *Regiment of the Sea*] (...) & then sketch out my Hanoverian theme. The worst of it is that there is no climax - it just fades out with the coming of the factories & the 'pure' scientist & the new Universities and schools - & of course systematic navy training.

And in March 1963, writing again to Michael Richey, as often while lying in bed:

I am in the middle of Chap VI (out of VIII) of the Hanoverian Practitioners; but it is hard going to make a narrative out of such a mass of detail. I like to have a hero like Dee or Hooke.

Here she referred to two big players in the first volume, the mathematical genius *John Dee, who for decades had given advice and instruction to pilots and navigators; and *Robert Hooke, whose 'extra-ordinary fertility of invention' had produced, beside much else, a self-recording log, a backstaff fitted with a lens to avoid penumbra, and an early form of sextant.

But she managed to complete the text before, in 1964, the stroke rendered her incapable of further work, and between them, Michael Richey and Eila Campbell got the book through the press. It appeared in the year of her death, 1966.

Appraisal

How does Eva Taylor's work stand the test of time? Is it still read and consulted two, three generations later? Both volumes of *The Mathematical Practitioners*, as well as her earlier works on *Tudor and Early Stuart Geography* are on the open shelves in the British Library, in two reading rooms, Humanities I and the Map Room, so they are considered useful reference works and one may presume that they are still regularly being consulted. As for *The Mathematical Practitioners*, on which I am best informed, the first volume was reprinted three times in the 1960s, and in 1989 an American dealer of antique scientific instruments and rare books in that field, The Gemmary, published a photomechanic reproduction of both volumes. Clearly, there was continued demand for them.

But there were also shortcomings. Already in 1955 Derek Price had written with regret:

Since so many other people will have to follow in her footsteps, it is a pity that she has not been more generous in providing chapter and verse for the information she makes available in this book. [...] It would have been impossible to authenticate and footnote each item, but one cannot help feeling

that future scholars will sometimes have a difficult if not impossible task in duplicating Professor Taylor's searches.¹¹

It is indeed fair to say that her sparse, almost laconic referencing has caused some frustration among later researchers. Her idiosyncratic system of indexing has also come in for criticism,¹² as has the quality of her information itself. Researchers who looked at individual practitioners in detail realized that many of her short biographies were incomplete or even unreliable; a reviewer of the 1989 reprints of *The Mathematical Practitioners* wrote that they should have come with a government health warning.¹³ But then, this is not unusual for a work of such scope, and we can be grateful for what others have done since Taylor's death. The bio-bibliography of eighteenth-century British mathematicians has been taken to new levels of completeness and sophistication by Peter and Ruth Wallis.¹⁴ Anyone looking for reliable data on instrument makers knows that Taylor's pioneer volumes are no longer the first port of call and will turn to Gloria Clifton's magnificent *Directory*.¹⁵ And for yet another sub-group of the mathematical practitioners, the land surveyors and map-makers, updated biographical information has also been made available recently.¹⁶ To complete this stock-taking exercise, let me quote Stephen Johnston, curator at the Museum of the History of Science in Oxford. His PhD dissertation is an in-depth study of a small group of Elizabethan mathematical practitioners. Here he is speaking about what he called the first generation of writers on the mathematical practitioners', Eva Taylor as well as F. R. Johnson and Commander David Waters:

The classic text is E. G. R. Taylor's *Mathematical Practitioners of Tudor and Stuart England* (1954), in which the historical terrain of mathematical practice was first identified and its coherence demonstrated at length. [...] Many of the assembled characters would previously have been considered too obscure or insignificant to merit serious study. But when gathered together, Taylor was able to reconstruct a didactic, urban and vernacular tradition, in which instrument makers and ordinary textbook writers had a place alongside better known names from the history of science. [...] A great deal of the work of that first generation of Taylor, Johnson, Waters *et al.* still stands securely. But it

¹¹ See previous note.

¹² To put right the deficiency that Taylor's index to the second volume excludes anyone accorded fewer than six lines (!), a dealer in antique instruments, Harriet Wynter, commissioned the compilation of an index to Volume 2, published in 1980. In some libraries, this 24-page index has been bound into the Hanoverian volume.

¹³ Jon Darius in *Bulletin of the Scientific Instrument Society*, 27, 1990, pp. 31-2.

¹⁴ P. J. & R. V. Wallis, *Index of British Mathematicians 1701-1760*, Newcastle upon Tyne, 1967, followed by updates and extensions: *Biobibliography of British Mathematics and its Applications. Part II, 1701-1760*, Newcastle upon Tyne, 1986, and *Index of British Mathematicians Part III. 1701-1800*, Newcastle upon Tyne, 1993. An appraisal of Taylor's *Mathematical Practitioners* by P. J. Wallis, 'British Mathematical Biobibliography', appeared in *Journal of the Institute of Navigation*, 20, 2, April 1967, pp. 200-205.

¹⁵ G. C. Clifton, *Directory of British Scientific Instrument Makers 1550-1851*, general editor G. L. E. Turner, London: Zwemmer and National Maritime Museum, 1995, xviii + 331 pp.

¹⁶ *Dictionary of Land Surveyors and Local Map-Makers of Great Britain and Ireland 1530-1850, Compiled from a Variety of Sources ... by Francis Steer [et al.] and edited by Peter Eden*, 2nd edition by Sarah Bendall, London, 1997, 2 vols.

should come as no surprise that there are points of detail open to correction and that new interpretations and emphases can be placed on their material.¹⁷

Conclusion

With her two monumental volumes, produced when she was in her seventies and eighties, Eva Taylor put the mathematical practitioners, as it were, 'on the map'. And I am sure that she would have been the first to applaud the later generations who followed up with new research, correcting and expanding her biographical and bibliographical databases, and taking the study of the mathematical practitioners into the twenty-first century.

Eva Taylor by no means lived only 'in the past'. Nevertheless, perhaps it is true to say that she did feel most at home in the early-modern period about which she was so knowledgeable. And since I have offered you only one portrait of her, let me, as a parting shot, quote what Professor Mead wrote to me about the grand old lady:

Gossiping about her, she might be referred to as a model Tudor chatelaine – perhaps better still, a stalwart Elizabethan matriarch. In the right costume, she would fit happily into the Tudor gallery at the National Portrait Gallery.

APPENDIX

Books by E. G. R. Taylor

Tudor Geography 1485-1583, London: Methuen & Co., 1930. ix + 290 pages. With 16 plates. 8°.

Late Tudor and Early Stuart Geography, 1583-1650. A Sequel to "Tudor Geography, 1485-1583", London: Methuen & Co.: London, 1934, ix+ 322 pages. With 8 plates. 8°.

The Haven-Finding Art. A History of Navigation from Odysseus to Captain Cook, London: Hollis & Carter, 1956, xii + 295 pages. 8°. Five years after her death appeared a new edition, with an appendix 'Navigation in Medieval China' by Joseph Needham (London : Hollis and Carter for the Institute of Navigation, 1971).

With Michael Richey: *The Geometrical Seaman. A Book of Early Nautical Instruments*, London: Hollis & Carter for the Institute of Navigation, 1962, viii + 111 pages. 8°.

¹⁷ Making Mathematical Practice: Gentlemen, Practitioners and Artisans in Elizabethan England' (Ph.D., 1994), pp. 38-9. The text of his (mostly unpublished) doctorate is available on his website at <http://www.mhs.ox.ac.uk/staff/saj>

The Mathematical Practitioners of Tudor & Stuart England, University Press: Cambridge, 1954, published for the Institute of Navigation, xi + 442 pp. 8°. An unaltered second edition appeared in 1967

The Mathematical Practitioners of Hanoverian England, 1714-1840 (University Press: Cambridge, 1966. Published for the Institute of Navigation). xv + 502 pp. 8°.

Works edited by E. G. R. Taylor for the Hakluyt Society

A Brief Summe of Geographie / by Roger Barlow, Edited with an Introduction and Notes by E. G. R. Taylor, D.Sc., F.R.G.S. 1932 (1931). lvi + 210 pp. With 1 map, 3 illustrations. Second series 69.

The Original Writings & Correspondence of the Two Richard Hakluyts, With an Introduction and Notes by E. G. R. Taylor, ... , Professor of Geography, University of London, 1935.

Volume I. xiv + 210pp. With 2 maps, 4 illustrations.

Volume II. xii + 211-516 pp.

Second series 76 and 77.

The Troublesome Voyage of Captain Edward Fenton 1582-1583, Narratives & Documents edited by E. G. R. Taylor, Emeritus Professor of Geography in the University of London, Cambridge, 1959 (1957). lvii + 333. With 9 maps, 12 illustrations.

Second series 113.

A Regiment for the Sea and other Writings on Navigation by William Bourne of Gravesend, a Gunner (c. 1535-1582), edited by E. G. R. Taylor, ... Cambridge, 1963 (1961). xxxv + 464. With 7 maps, 9 illustrations.

Second series 121.

Other contributions by E. G. R. Taylor to Hakluyt Society publications

Select Documents illustrating the Four Voyages of Columbus Vol. II: The Third and Fourth Voyages. With a Supplementary Introduction by E. G. R. Taylor. 1933 (1932). lxxxix + 164. With 3 maps, 1 illustration.

Second series 70.

Mandeville's Travels: Texts and Translations by Malcolm Letts, FSA. Volume I. 1953 (1950). lxiii + 223. With 2 maps, 1 illustration. The text of British Library Egerton MS 1982, with an essay on the cosmographical ideas of Mandeville's day by E. G. R. Taylor. Second series 101.

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Owen Tudor, a Welsh landowner, fought in the armies of King Henry V of England. When Henry died, Owen married the widow, Catherine of Valois, and then fought in the service of her son, Henry VI. Lady Jane Grey is the great tragic figure of the Tudor era. Thanks to the machinations of John Dudley, Edward VI was initially succeeded by Lady Jane Grey, fifteen-year-old great-granddaughter of Henry VII and devout Protestant. But Mary's life isn't just a tale of religious killing. She was desperate for an heir, resulting in a false but very advanced pregnancy, and as a woman fighting to rule a nation, broke the barriers Elizabeth later walked through. Historians are now assessing Mary in a new light. Elizabeth I.

It is described in his book *Mathematical Principles of Natural Philosophy*. The fundamental principle of the book is that "every particle of matter is attracted by every other particle of matter with a force inversely proportional to the square of their distances apart". Applying the principle of gravitation, Newton proved that the power which guides the moon around the earth and the planets around the sun is the force of gravity. Logic, Symbolic and mathematical, Thought and thinking, Probabilities. Publisher. London : Walton and Maberly. Collection. cdl; americana. Openlibrary_work. OL2630395W. Pages. FOUNDATIONS OF MATHEMATICAL ECONOMICS 1 Sets and Spaces All is number. Pythagoras God created the integers; everything else is the work of man. Kronecker One of the most important steps in understanding mathematics is to build a framework to relate and integrate the various components and pieces of information. The principal function of this introductory chapter is to start building this framework, reviewing some basic concepts and introducing our notation.